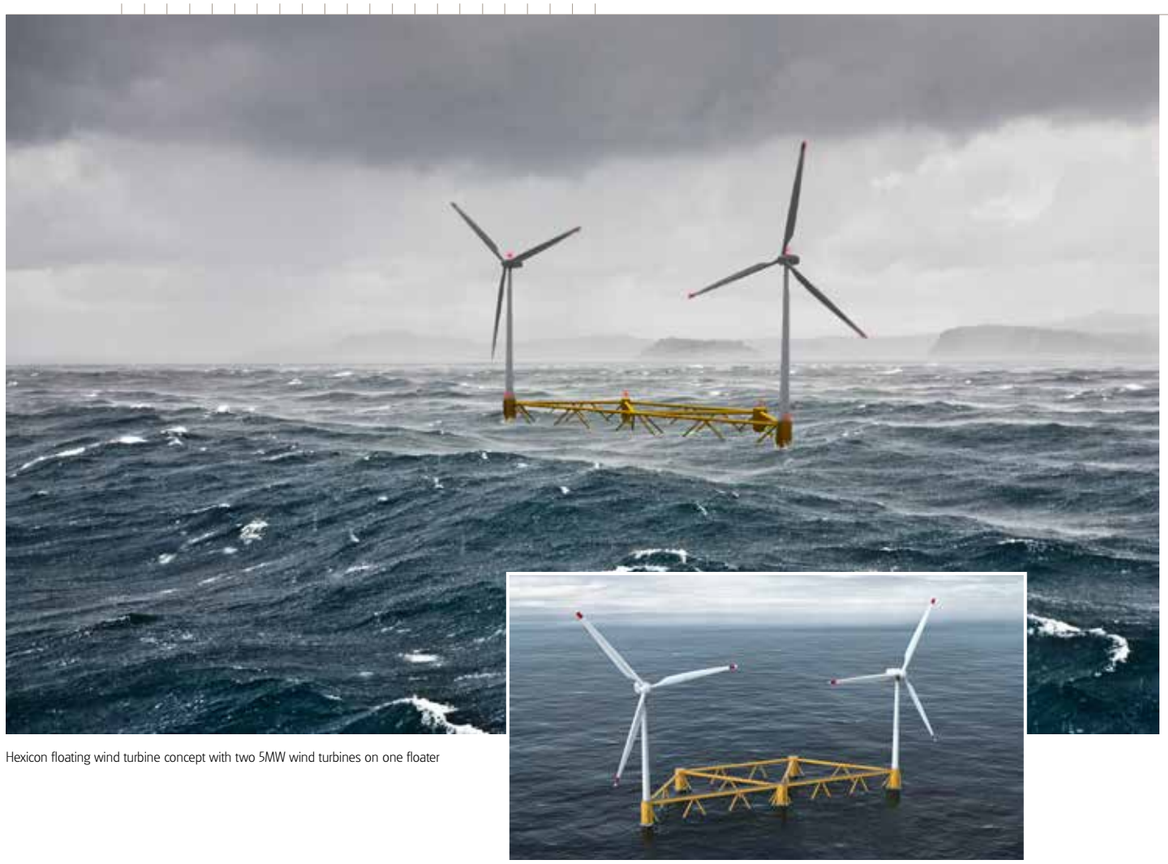

Hexicon floating wind turbine concept with two 5MW wind turbines on one floater

MARIN's latest involvement in floating wind energy

A multi-turbine, floating concept will be tested in the offshore basin for the first time this year as floating wind energy takes the next step. Additionally, MARIN is working on a vertical axis wind turbine model.

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MARIN has been involved in floating wind turbines right from the start of their development. The first floating project MARIN participated in was 'Drijfwind' in 2003, but this was limited to testing only the floater, without the wind turbine, to determine the global floater response in waves and current.

A few years later in 2011 MARIN performed scale model tests for three different floating wind turbine concepts for the DeepCwind Consortium (USA), in a project led by the University of Maine. For these unique model tests MARIN and the DeepCwind Consortium worked closely together to develop a new, high quality wind generation machine in the MARIN Offshore Basin. This wind generation machine also gave the opportunity to model the wind turbine during model scale tests.

This innovative approach now made it possible to model the complex motions and loads of the rotating wind turbine on a moving platform in both wind and waves. To simulate the motions and loads accurately it is important that the thrust load generated by the wind turbine is simulated correctly in the basin. Due to Reynolds scale effects, the model tests showed that the wind turbine generated a lower thrust, resulting in lower loading on the floaters.

Stock wind turbine A new scaling method for the model scale wind turbine was developed which improved the quality of model testing. This method was then used to develop a new, generic, model scale wind turbine, which was constructed at MARIN. Incorporating an active pitch control to test different control systems in the basin, this stock wind turbine is available for new projects, reducing the cost of model testing. Since 2013 this MARIN stock wind turbine has been operational and used for testing more than seven new floating wind turbine concepts. One of the latest projects taking advantage of the wind turbine was the floater developed by SBM Offshore in cooperation with IFPEN.
This year MARIN will test a multi-turbine concept in the offshore basin for the first time. The Swedish design and engineering company Hexicon has developed this new floating wind turbine concept with two 5MW wind turbines on one floater. The first prototype is expected to be installed in the North Sea in 2018. MARIN performed concept tests in 2015 to generate valuable data to tune the first simulations to investigate if the concept was achievable.

Valuable insight During the concept tests the preparation time and cost could be kept to a minimum by implementing some simplifications without influencing the global performance of the floater too much. These included using a smaller scale of 1:80 and the tests were modelled in a soft mooring setup rather than modelling a full mooring system. The wind turbine thrust was modelled with tension generated by a weight instead of modelling the complete turbine.

After the tests the client has valuable insight into the global response of the floater and the design could be further optimised. This optimised design will be tested this year at MARIN but with a much more detailed test setup. One wind turbine will be modelled with the MARIN stock turbine, while the forces on the second turbine will be modelled with wires attached to winches. These winches will be actively controlled during the tests, mirroring the forces measured at the MARIN stock turbine.

And continuing its pioneering research into offshore wind developments, MARIN is working on a vertical axis wind turbine model, which can be used for testing floating wind turbine concepts. MARIN is also participating in the S4VAWT joint project, whereby a number of research and industry partners are focusing on developing better tools (numerical and physical) for testing and optimising vertical axis floating wind turbine concepts.

Model testing for SBM floater